

NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

CONSTRUCTED WETLAND

(No.)

CODE 656

DEFINITION

A constructed shallow water ecosystem designed to simulate natural wetlands.

type, or functions that occurred naturally on site.

PURPOSE

To reduce the pollution potential of runoff and wastewater from agricultural lands to water resources.

CONDITIONS WHERE PRACTICE APPLIES

- Where a constructed wetland is a component of a planned conservation system or agricultural waste management system;
- Where wastewater or runoff originates from agricultural lands including livestock or aquaculture facilities; and
- Where a constructed wetland can be constructed, operated and maintained without polluting air or water resources.

This practice *does not* apply to:

- wetland restoration (657) intended to rehabilitate a degraded wetland where the soils, hydrology, vegetative community, and biological habitat are returned to original conditions;
- wetland enhancement (659) intended to rehabilitate a degraded wetland where specific functions and/or values are enhanced beyond original conditions; or
- wetland creation (658) for creating a wetland for purposes other than treating runoff and waste water on a site location which historically was not a wetland, or was a wetland with a different hydrology, vegetation

CRITERIA

General Criteria Applicable To All Purposes

Laws and Regulations. All federal, state, and local laws, rules and regulations governing the use of constructed wetlands must be followed. Constructed wetlands for waste treatment shall not be designed to discharge to waters of the state unless permitted by state laws and regulations, and appropriate permits have been obtained to do so. In addition, if discharge is permitted, the receiving surface water must have the capacity to assimilate the constructed wetland's effluent during low flow periods.

Location. Constructed wetlands shall be located outside the limits of wetlands of any classification.

Constructed wetlands located within a floodplain shall be protected from inundation or damage from a 25-year flood event, or larger if required by laws, rules, and regulations.

Constructed wetlands shall be located to provide sufficient separation distances from structures such as residences and commercial buildings so prevailing winds and landscape elements such as building arrangement, landforms, and vegetation will minimize odors and protect aesthetic values. They shall be located with a separation distance that will minimize the potential for contamination of ground water resources. This distance shall be in accordance with laws, rules and regulations.

Type. Constructed wetlands shall be designed as surface flow systems consisting of adequate seepage control, a suitable plant medium, rooted emergent hydrophytic vegetation, and the structural components needed to contain and control the flow.

Influent. The influent to the constructed wetland shall be pretreated to reduce the concentrations of solids, organics, and nutrients to levels that will be tolerated by the wetland system and not cause excessive accretion within the wetland.

Where significant sediment and organic debris are expected in the wastewater or runoff to be treated, provisions for its entrapment before entry into the wetland must be provided.

Water budget. A water budget that evaluates runoff or wastewater volumes, precipitation, evaporation, and water use shall be used to determine the required hydraulic retention time in the wetland and storage requirements of the wetland pretreatment and post treatment facilities when included.

Embankment. The perimeter embankment shall have a minimum top width of 10 to 15 feet, and interior embankments shall have a minimum top width of 8 feet, unless site conditions or owner preference result in a narrower top width. In such cases, the Operation and Maintenance plan must reflect the additional effort required for vegetation maintenance and embankment repair. All embankment side slopes shall be a minimum of a 2 horizontal to 1 vertical.

Vegetation. Vegetation selected for the constructed wetland shall be hydrophytic plants suitable for local climatic conditions and tolerant of the concentrations of nutrients, pesticides, and other constituents in the runoff or wastewater stream and selected for their treatment potential.

Preference shall be given to native wetland plants with localized genetic material. Plant materials collected or grown from material collected within the same Major Land Resource Area (MLRA) are considered local.

Planting medium. The soil used for the planting medium shall have a cation exchange capacity, pH, electrical conductivity, soil organic matter, and textural class that is conducive to wetland plant growth and retention of contaminants.

Seepage control. The constructed wetland shall be located in soils with an acceptable permeability (1×10^{-7} cm/sec, or lower if required by regulation), or it shall be lined. Measures for controlling seepage shall be designed according to the procedures of NEH Part 651, Agricultural Waste

Management Field Handbook, Appendix 10D, "Geotechnical Design and Construction Guidelines."

Safety. The wetland shall be fenced as needed to exclude livestock and protect people.

Additional Criteria For Wetlands Constructed For Waste Treatment

Topography. Site topography shall accommodate the requirements for length to width ratios of the wetland and the wetland cells, and the requirement that the wetland cells be level side to side with grades of less than 0.05 ft/ft lengthwise.

Inlet. An inlet structure that will allow control of flow discharged to the wetland and screening of influent to prevent debris from entering the wetland shall be provided. Design of the inlet structure shall assure its function throughout the life of the wetland considering accretion.

Influent. Constructed wetlands for wastewater treatment shall not allow for direct inclusion of contaminated and/or uncontaminated runoff.

Wastewater will be of sufficient volume and duration to keep the constructed wetland moist at all times or accommodations shall be made for the addition of supplemental water.

Surface Area. The surface area of the wetland shall be determined using a recognized design procedure in consideration of loading, temperatures, and the desired level of treatment for the contaminants of concern.

Configuration. The constructed wetland shall have an overall length to width ratio of 1:1 to 4:1. Individual cells within the constructed wetland shall have a length-to-width ratio of 10:1 to 15:1. The wetland shall consist of at least two rows of parallel cells.

Flow depth. The design depth shall be based on the most severe season of operation, the desired level of treatment, and the required littoral zone of the plant species being used. The design depth shall be a minimum of 4 inches and a maximum of 18 inches.

Embankments. Height of the constructed wetland perimeter embankment shall be the sum of the following:

- Design depth
- Wetland accretion -- a minimum of 1 inch per year for the design life
- 25-year, 24-hour precipitation
- 12 inches of freeboard

The height of wetland's interior embankments shall be the minimum of the sum of the following:

- Normal design flow depth
- Wetland accretion -- minimum of 1 inch per year for the design life

Outlet. Constructed wetlands will discharge to storage facilities to allow for land application or recycled through the waste management system unless federal, state and local regulation allow discharge to waters of the state.

An outlet structure shall be provided that allows maintenance of proper water level in the wetland and controls the flow from the wetland.

Overflow Device. An ungated overflow device shall be provided to operate when the 25-year, 24-hour precipitation is exceeded. The overflow device shall operate without infringing on the wetland perimeter embankment's freeboard.

Additional Criteria For Wetlands Constructed For Runoff Treatment

Design Storm. The constructed wetland system shall be designed to contain a 2-year storm runoff. Limited area sites handling only the "first flush" volume shall have a minimum capacity to store 0.5 inch of runoff volume from the entire drainage area. When less than full runoff is stored, bypass of the excess storm flow shall be provided.

Detention time and surface area. The detention time and surface area shall be calculated on the time required to achieve the required level of treatment based on the limiting contaminant present.

Wetland Cells. Length-to-width ratios are to be 4:1 to 10:1. Other dimensions and shapes that provide a more natural landscape appearance that meet treatment requirements can be used.

The standard for Dike (356) shall be used as appropriate. Refer to the Engineering Field Handbook, Chapters 13, "Wetland Restoration, Enhancement, and Creation," and 6, "Structures," for design information. Existing drainage systems will be utilized, removed, or modified as needed to achieve the intended purpose.

Depth. Maximum water depth shall be 24 inches except in those instances where deep water areas are included as a special design.

Outlet. A water control structure to automatically regulate storage release in accordance with the design detention time shall be installed.

CONSIDERATIONS

Locate constructed wetlands downgrade and as near the source of wastewater as practical.

Install measures to exclude or minimize attractiveness of the constructed wetland to wildlife that could be adversely affected by the constructed wetland. Take measures to exclude burrowing animals should they frequent the wetland. Consider the use of fences as an exclusion measure.

Recycle constructed wetland effluent back through the agricultural waste management system when practical.

In northern cold climates consideration should be given to storage of wastewater during winter months instead of wetland operation.

Add additional height to embankments to accommodate accumulated ice when constructed wetlands are used in cold climates.

When practical, add components or manage the wetland system to dose the wetland with influent every 2 or 3 days (or longer) to allow time for treatment of previous doses.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans shall include construction sequence, vegetation establishment, and management and maintenance requirements.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design.

Operational requirements should include:

- Maintenance of water level in wetland cells appropriate for vegetation.
- Control flow to wetland according to water budget, and to avoid shocking the wetland plants with pollutants.
- Requirements to allow acclimation of wetland plants to flooding and contaminants, including any waiting period prior to introducing pollutants to the wetland.
- Monitoring of wetland performance.
- Sampling effluent for nutrients prior to utilization.
- Surveillance of inlet and outlet.

Maintenance requirements should include:

- Maintenance of any pretreatment components to ensure proper loading of pollutants into wetland.
- Repair of embankments.
- Control of vegetation.
- Removal of debris that block flow paths in the wetland.
- Repair of fences or other ancillary features.
- Replacement of wetland plants.
- Repair of pipelines.
- Control of unwanted animals (varmints) or vectors (mosquitoes).

REFERENCES

Agricultural Waste Management Field Handbook, Part 651, National Engineering Handbook, USDA-NRCS.

Chapter 2 – Planning Considerations

Chapter 4 – Waste Characteristics

Chapter 7– Geologic & Ground Water Considerations

Chapter 8 – Siting Agricultural Waste Management (AWM) Systems

Chapter 9 – AWM Systems

Constructed Wetlands, Part 1, Animal Waste Treatment, National Engineering Handbook, Part 637, Environmental Engineering, Chapter 3, USDA-NRCS.

Guiding Principles for Constructed Wetlands: Providing Water Quality and Wildlife Habitat, Interagency Workgroup on Constructed Wetlands, 1999.

Handbook of Constructed Wetlands, A Guide to Creating Wetlands in the Mid-Atlantic Region, Interagency Corp Group, 1995

Volume 1 – General Considerations

Volume 3 – Agricultural Wastewater

Nutrient and Sediment Control System, Environmental Quality Technical Note N4, 1995, USDA-NRCS